OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **OTTER LAKE** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *fairly stable* in-lake chlorophyll-a trend. Concentrations in July were slightly higher, and rain the day before could have washed excess nutrients into the lake and caused an increase in algal growth. Algal abundance remains low in the lake, and continues to be below the average value for NH lakes. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *stable* trend in lake transparency. Mean transparency values were above the NH mean reference line for the first time since Otter Lake joined the VLAP program! We would like to see this trend continue for the lake. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. The upper graph shows a *fairly stable* trend for in-lake phosphorus. Phosphorus concentrations in the upper water layer were slightly elevated in August, but did not contribute to an excess of algal growth at that time. *In August, it was noted that the hypolimnetic phosphorus bottle contained a large amount of bottom sediment, which raised the phosphorus concentration of the sample. This value was not included in this year's graph, as the result would unnecessarily skew the trend line.* Please begin collecting only one sample from the deep spot on each sampling day; the water column is not stratified, so only one sample is necessary to determine water quality. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- We would like to thank our new monitor, Sue Beaupre, for her diligent sampling efforts this summer! The increase in sampling frequency of once per month from June to August allows for more accurate trend analyses of the data. Increased sampling also allows us to better determine the lake quality and to identify and resolve problems as they occur. We hope to see this sampling regime continue in the 2001 season.

- In 2000, small amounts of the blue-green algae *Microcystis* and *Anabaena* were observed in the plankton sample (Table 2). Blue-green algae can reach nuisance levels when sufficient nutrients and favorable environmental conditions are present. While overall algal abundance continues to be low in the lake, the presence of these indicator species should serve as a reminder of the lake's delicate balance. Continued care to protect the watershed by limiting or eliminating fertilizer use on lawns, keeping the lake shoreline natural, and properly maintaining septic systems and roads will keep algae populations in balance.

- Conductivity in the hypolimnion appears to have increased this season (Table 6). Conductivities in 1999 were similar to those from this season. Conductivity in Otter Lake is higher than desired, and we would like to see a decrease in this trend. Conductivity increases often indicate the influence of human activities on surface waters. Septic system leachate, agricultural runoff, iron deposits, and road runoff can all influence conductivity. It would be useful to uncover the reasons for the slightly elevated in-lake conductivities as we continue to monitor the lake.

- On two occasions this year the turbidities of the hypolimnion (lower water layer) were high. This would indicate that the samples contained bottom sediment (See Notes). The sediment, which can have phosphorus bound to it, can raise phosphorus concentrations of the sample and yield inaccurate results. When sampling, please be sure to take the sample at least 1 meter off the bottom to avoid contamination with sediment. If the sample is visibly cloudy, we recommend re-taking it to try to obtain a cleaner sample.

- Oxygen concentrations were high throughout the water column in June (Table 9). Shallow ponds tend to mix continuously due to wind and wave action, thereby allowing for oxygen exchange with the atmosphere.

NOTES

- Monitor's Note (7/19/00): Breezy, rain previous day.

- Monitor's Note (8/23/00): 3 loons swimming and diving nearby.

- Biologist's Note (8/23/00): Total phosphorus bottle contained a large amount of sediment.

USEFUL RESOURCES

Stormwater Management and Erosion and Sediment Control Handbook. NHDES, Rockingham County Conservation District, USDA Natural Resource Conservation Service, 1992. (603) 772-4385.

Comprehensive Shoreland Protection Act, RSA 483-B, WD-BB-35, NHDES Fact Sheet. (603) 271-3503 or www.state.nh.us

Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Diet for a Small Lake: A New Yorker's Guide to Lake Management. Federation of Lake Associations, Cazenovia, NY, 1990. (315) 655-4760

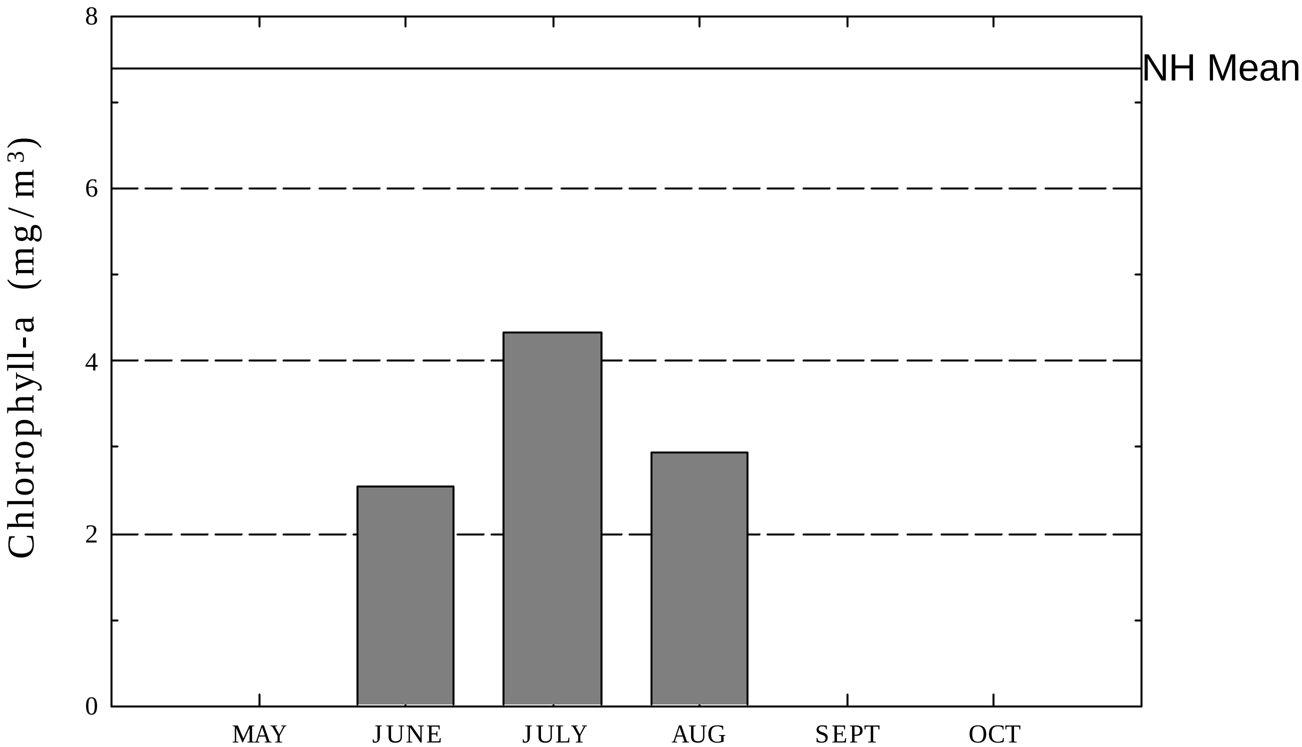
Road Salt and Water Quality, WD-WSQB-7, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

The Blue Green Algae. North American Lake Management Society, 1989. (608) 233-2836 or www.nalms.org

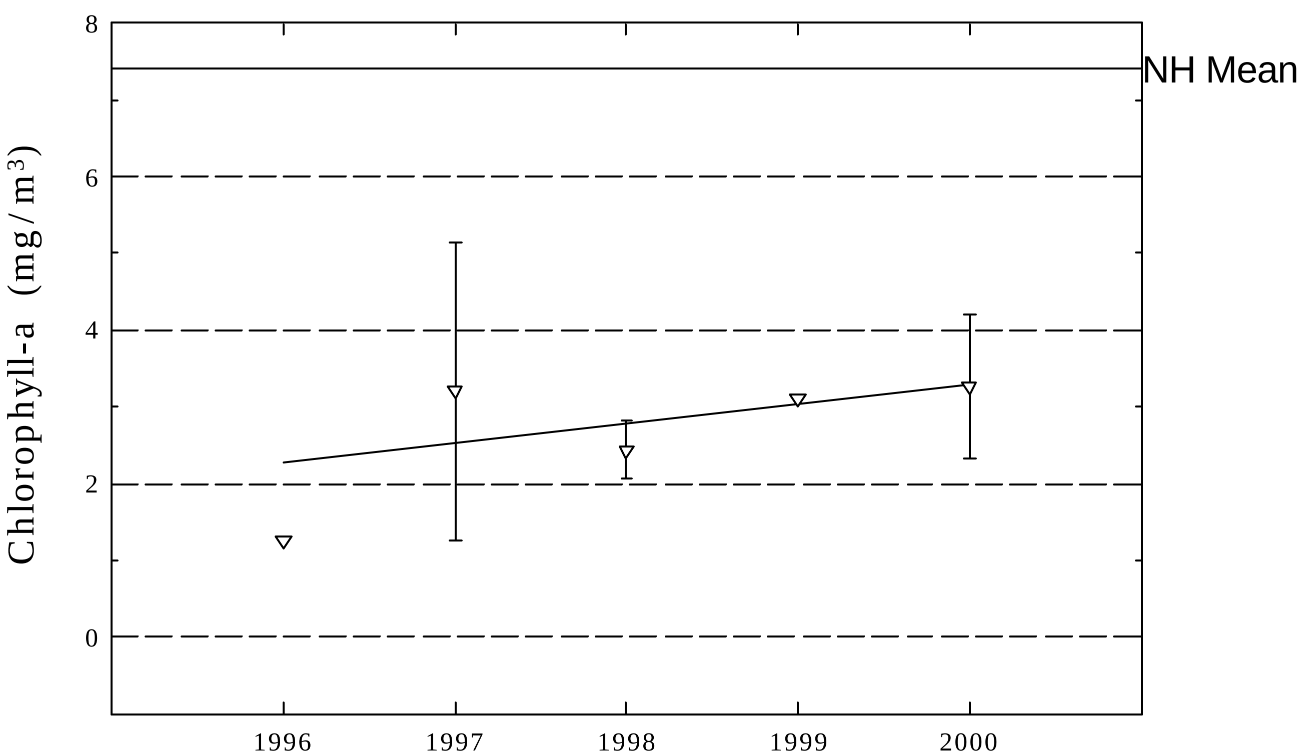
2000

Otter Lake

Figure 1. Monthly and Historical Chlorophyll-a Results



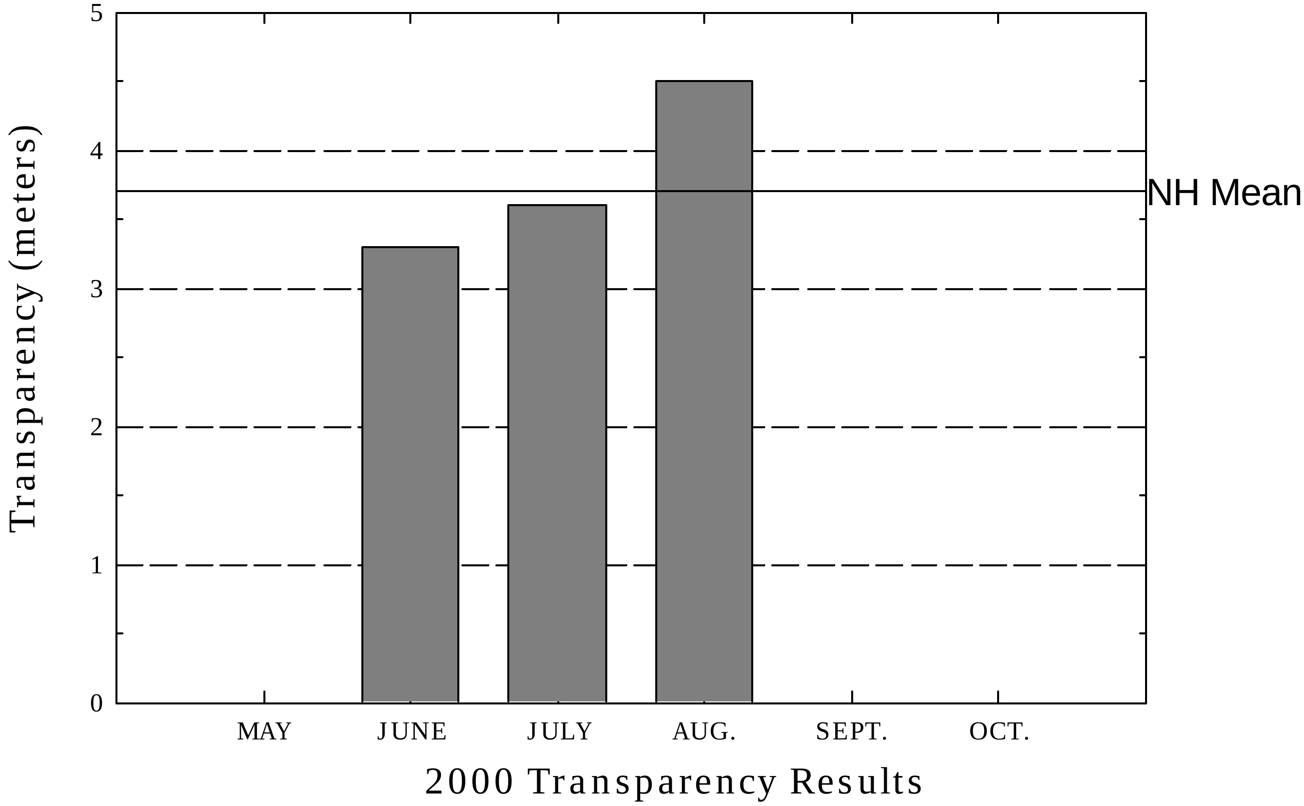
2000 Chlorophyll-a Results

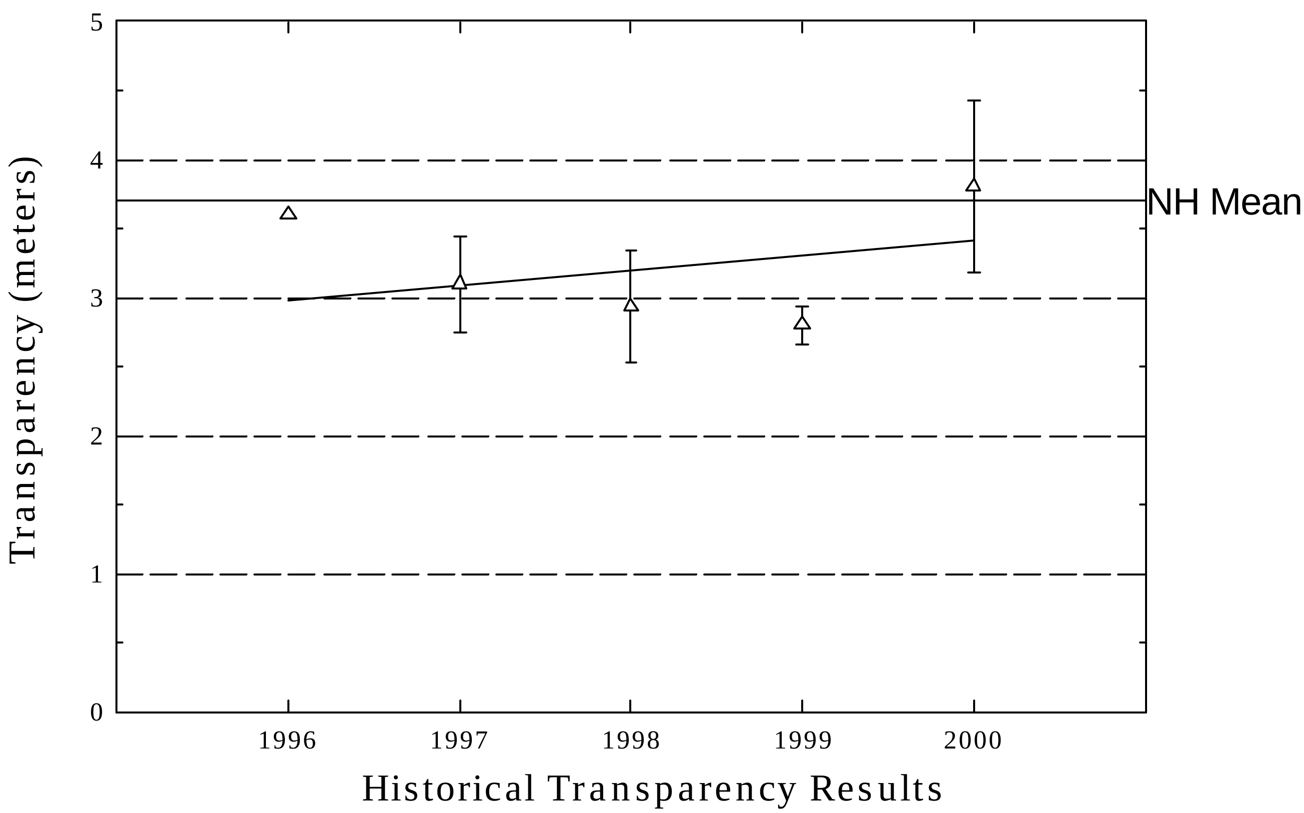


Historical Chlorophyll-a Results

Otter Lake

Figure 2. Monthly and Historical Transparency Results





Otter Lake

Figure 3. Monthly and Historical Total Phosphorus Data.

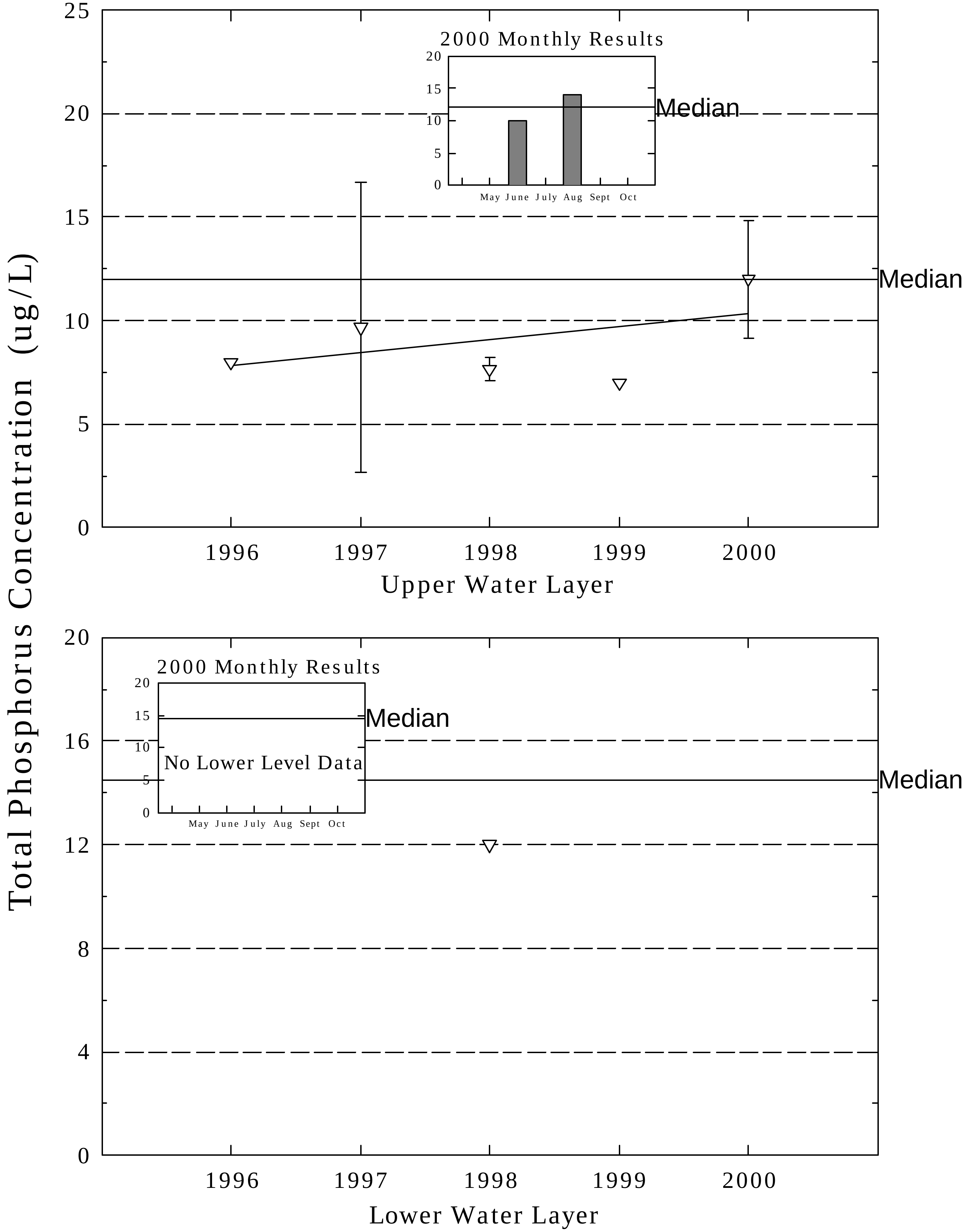


Table 1.

OTTER LAKE

GREENFIELD

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1996	1.26	1.26	1.26
1997	2.02	5.45	3.21
1998	2.01	3.84	2.78
1999	3.11	3.11	3.11
2000	2.54	4.33	3.26

Table 2.

OTTER LAKE

GREENFIELD

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
09 / 06 / 1996	COELOSPHAERIUM	45
	CHRYSOSPHAERELLA	23
	MELOSIRA	10
06 / 27 / 1997	DESMIDEUM	49
	ASTERIONELLA	30
	SYNEDRA	8
07 / 02 / 1998	CHRYSOSPHAERELLA	50
	SYNEDRA	20
	DINOBRYON	10
09 / 01 / 1998	DINOBRYON	57
	COELOSPHAERIUM	11
	ASTERIONELLA	9
07 / 02 / 1999	DINOBRYON	59
	CHRYSOSPHAERELLA	34
	COELOSPHAERIUM	3
06 / 21 / 2000	SYNURA	66
	CERATIUM	11
	DINOBRYON	9

Table 3.

OTTER LAKE

GREENFIELD

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1996	3.6	3.6	3.6
1997	2.7	3.3	3.1
1998	2.5	3.3	2.8
1999	2.7	2.9	2.8
2000	3.3	4.5	3.8

Table 4.

OTTER LAKE
GREENFIELD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1996	6.83	6.83	6.83
	1997	6.87	6.89	6.88
	1998	6.63	6.93	6.78
	1999	6.90	6.90	6.90
	2000	6.68	6.81	6.75
HYPOLIMNION				
	1998	6.45	6.45	6.45
	2000	6.83	6.87	6.85
INLET AT DAM				
	1996	6.36	6.36	6.36
INLET				
	1997	6.48	6.60	6.55
	1998	6.16	6.57	6.36
	1999	6.37	6.46	6.41
	2000	6.42	6.49	6.46
OUTLET				
	1996	6.62	6.62	6.62
	1997	6.69	6.94	6.82
	1998	5.96	6.95	6.35
	1999	6.75	6.78	6.76
	2000	6.73	6.81	6.78

Table 5.

OTTER LAKE

GREENFIELD

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1996	7.40	7.40	7.40
1997	7.50	8.50	8.00
1998	6.00	8.30	7.25
1999	7.50	7.50	7.50
2000	6.80	7.20	7.00

Table 6.

OTTER LAKE
GREENFIELD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1996	108.5	108.5	108.5
	1997	100.7	103.6	101.9
	1998	86.8	104.5	94.4
	1999	110.7	110.7	110.7
	2000	109.3	120.2	115.8
HYPOLIMNION				
	1998	88.4	88.4	88.4
	2000	119.0	121.1	120.0
INLET AT DAM				
	1996	93.8	93.8	93.8
INLET				
	1997	82.0	97.0	90.3
	1998	80.8	95.6	90.5
	1999	92.3	103.8	98.0
	2000	96.4	103.4	99.6
OUTLET				
	1996	109.4	109.4	109.4
	1997	102.5	107.6	104.3
	1998	91.0	97.3	93.8
	1999	112.8	116.6	114.7
	2000	111.3	117.0	114.9

Table 8.

OTTER LAKE
GREENFIELD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1996	8	8	8
	1997	3	17	9
	1998	7	9	8
	1999	7	7	7
	2000	10	14	12
HYPOLIMNION				
	1998	12	12	12
	2000	904	904	904
INLET AT DAM				
	1996	9	9	9
INLET				
	1997	8	12	10
	1998	5	14	9
	1999	9	11	10
	2000	7	9	8
OUTLET				
	1996	6	6	6
	1997	4	29	14
	1998	6	15	10
	1999	5	12	8
	2000	7	10	8

Table 9.

OTTER LAKE

GREENFIELD

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
June 21, 2000			
0.1	21.5	8.0	90.1
1.0	21.1	8.0	89.9
2.0	20.4	8.0	88.1
3.0	18.5	7.2	76.9

Table 10.

OTTER LAKE

GREENFIELD

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
September 6, 1996	3.5	23.0	6.2	72.0
June 27, 1997	3.0	23.5	8.3	96.0
July 2, 1998	4.0	18.2	2.0	21.0
September 1, 1998	3.0	23.1	7.4	86.0
July 2, 1999	2.5	24.7	7.7	93.2
June 21, 2000	3.0	18.5	7.2	76.9

Table 11.

OTTER LAKE

GREENFIELD

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1997	0.3	0.6	0.5
	1998	0.5	0.6	0.5
	1999	0.5	0.5	0.5
	2000	0.3	0.5	0.4
HYPOLIMNION				
	2000	0.3	4.0	2.1
INLET				
	1997	0.3	0.6	0.5
	1998	0.4	1.2	0.7
	1999	0.3	0.7	0.5
	2000	0.4	0.4	0.4
OUTLET				
	1997	0.4	3.1	1.4
	1998	0.6	2.6	1.2
	1999	0.5	0.9	0.7
	2000	0.2	0.5	0.4

Table 12.

OTTER POND

SUNAPEE

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
BEACH		
	May 23	0
	June 20	2
	July 25	2
	August 21	0
	September 18	0
	September 18	0

NOTE: "<" means "less than" and ">" means "greater than"